

Hamilton (J. R.)

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mittee of the House of Commons, which condemned them both. The report of the committee precludes the construction of any tunnel until other ideas control the minds of the military authorities. The Duke of Cambridge, commander-in-chief, thought that the company should first of all be required to deposit in the treasury a sum sufficient to construct a first-class fortress and maintain a garrison of 10,000 men. The absolutely necessary military precautions demanded by him and General Wolseley, and indorsed by the committee, were that the tunnel's mouth should be beyond range from the sea, commanded by the guns of such a fortress, and provided with a portcullis. There should be arrangements at command from within the fort, and at different points outside, for filling the tunnel with asphyxiating gases, for temporarily flooding it by means of sluices, for closing the entrance with mines on the land, and for permanently flooding it by mines above the roof, opening communication with the bottom of the sea. Even these precautions would not satisfy the nervous warriors of England, who dread that the tunnel and its defenses might still be captured intact by a conquering army invading England by sea, and permanently held by the victors.

**EPIDEMIC DISEASES, SANITARY CONTROL OF.** The sanitary control of epidemic disease in the United States, or, rather, its attempted control, is of so recent origin that at the present day but little other than the results of limited experience which has been gained in the last few years can be recorded, leaving to the future the final collation of the accumulated evidence, and the settlement of the points involved. Enough has been learned, however, by that experience, and by the experience of foreign nations, to justify the assertion that the diseases now classed as epidemic may be placed under control. We say epidemic diseases, but, properly speaking, we should rather say that such diseases are of a specific nature, liable to be spread by certain material influences. There is at this time no reason for going into the discussion of the contagious or non-contagious nature of a class of diseases known to invade certain localities at certain seasons of the year, and to affect large numbers of the human family; for modern researches into the causation and origin of the class mentioned have proved beyond a doubt that they are produced by a certain germ or seed, capable, under favorable circumstances, of self-propagation, and communicable by certain recognized agents. Among these agents, air, drinking-water, and food, in the order named, are believed to be the principal infection-carriers. Researches of Pasteur, Koch, and others, have placed the germ or seed theory beyond dispute; and, although some doubt has been expressed as to the demonstration of the particular bacillus of each specific disease, yet their existence, and the general agreement among sanitarians as to the essential correctness

of the theory, that epidemics are consecutive and not synchronous, is, we think, established. There are five specific diseases which have prevailed at different periods in the history of mankind, about which the question of transmission is pretty clearly established. These are the Oriental plague, cholera, measles, small-pox, and yellow fever. There are certain other specific diseases, highly infectious in their nature, which, although rarely taking on the form of general epidemics, are yet transmissible by some one of the vehicles mentioned. These are typhoid fever, diphtheria, and scarlet fever. It is common to speak of all the affections above enumerated as preventable diseases, although it is best not to accept that term in its literal sense; for, while it is true that they may be prevented from becoming epidemic by means hereafter to be mentioned, yet it is doubtful if the germ can be swept from the face of the earth, except by a more united effort than has heretofore been made, or is likely to be made in the near future. It is, perhaps, scarcely in place to mention the diseases of animals belonging to this class, in this paragraph; but the experiments of Pasteur in regard to the prevention of chicken-cholera and silk-worm disease, and that of the veterinarians of this country in the prevention of pleuro-pneumonia and glanders, are directly corroborative of the prevailing theory regarding diseases peculiar to the human race. Without dwelling further on this phase of the question, we pass directly to the consideration of the essential characteristics of one of the diseases named. The plague is a contagious specific fever, attended with an eruption of carbuncles, and swelling of the inguinal and other glands of the body. Hecker, who has written an extensive work on this disease, assumes that Europe alone has lost no less than twenty-five millions of its inhabitants in the various epidemics of the plague that have occurred. He says: "In regard to the nature of the contagion, every spot which the sick had touched, their breath, their clothes, spread the contagion; and, as in all other places, the attendants and friends, who were either blind to their danger or heroically despised it, fell a sacrifice to their sympathy. The pestilential breath of the sick who expectorated blood caused a terrible contagion far and near; for even the vicinity of those who had fallen ill of the plague was certain death, so that parents abandoned their infected children, and all the ties of kindred were dissolved."

"The contagion of the plague appears to have frequently been conveyed by drinking water from the very inefficiently protected wells; hence there arose a cry that the wells were poisoned, and suspicion fell upon the Jews, who were almost everywhere racked and tortured, burned and massacred."

Dr. Russel states that "in the most destructive forms the vital forces appear to be suddenly annihilated by a most intense and malignant

blood-poisoning, and death is remarkably rapid, without external eruption of buboes, carbuncles, or spots. In such cases the body has no time to show the 'tokens' before death. In the great majority of cases the disease is preceded by lassitude, loss of strength, anxiety, and afterward by vomiting. The characteristic swellings in the arm-pits and groin follow, petechiae and carbuncles appear, delirium succeeds, and too frequently death. Pathology shows rather the effects of the poison on the tissues and organs, as shown by enlargement and congestion of the spleen, kidneys, etc., than anything especially characteristic. There are numerous haemorrhagic effusions, and dissection shows that buboes always result from enlargement and suppuration of the lymphatic glands. It is probable that all the fluids and secretions of the plague-stricken body are contagious" (Dr. Blythe, "Dictionary of Hygiene").

The symptoms of cholera, small-pox, and yellow fever, are so well known that no particular mention need be made of them in this place.

**CONVEYANCE OF INFECTION BY AIR.**—The atmosphere is essentially a diluent of all gaseous poisons. It has practically this effect in relation to germ-diseases, for it is evident that, when the germs are scattered through a large quantity of air, the propagation is retarded; for the seeds being less numerous, their effects are not so apparent; but the distance to which specific germs can be transmitted in the air can not at this time be definitely stated. The air, however, is always infected in the immediate vicinity of *fomites*, which is a rather vague term, meaning any substance which may retain germs from a plague- or fever-stricken patient. Thus there are included in this general term all textile fabrics which have been in contact with patients, such as clothes, rags, bedding, linen, and the like. It is reasonably certain that such fomites, having been in contact with the excreted or vomited matters, perspiration, or other exhalations from the skins of patients affected with some one of the specific diseases, afford a safe place of refuge for the germs; and if fomites be placed in boxes or trunks, or in bales, they retain the power of propagation through an indefinite period of time; and such fomites, when placed in favorable conditions, allow the transmission of the germs to the air surrounding them, and thus the contagion is supplied, to be disseminated from one place to another. In the epidemics of the plague in Asia, it has been demonstrated that rugs and the like, when carried to a place quite remote from the original place of infection, and opened out, have been a cause of the development of the disease in a new and before unaffected locality. This also accounts for the sudden outbreak of epidemics in remote points. In the cholera epidemic of 1873, in the United States, the Crow River settlements in Minnesota were free from cholera until the

opening of baggage at Willmar, brought thither by immigrants from Europe (McClellan, "Cholera Epidemic of 1873 in the United States," Washington, 1875, p. 441). It is believed to be a fact that the outbreak of yellow fever at Memphis, Tenn., in 1879, originated in the unpacking and airing of certain infected clothing that had been stored away since the terrible epidemic which had visited that city in the previous year; and such cases have been of so common occurrence as to give cause for a well-grounded fear of retaining year after year, in any house, textile fabrics which have directly or indirectly been in contact with yellow-fever patients. In regard to the general infection of the air, it has been demonstrated that a strong current of air, blowing over infected articles, will convey the germs in sufficient numbers to develop the disease in persons inhaling the infected air; and it has even been known to affect animals. For instance, the widely-known Ceeley case, reported in "Transactions of Provincial Medical and Surgical Association," quoted by Aitken ("Science and Practice of Medicine," vol. i, 1872, p. 400), as follows: "At the village of Oakley, about sixteen miles from the town of Aylesbury, small-pox had been epidemic from June to October, 1840. Two cottages, in which three persons resided during their illness, were situated, one on each of two sides of a long, narrow meadow, comprising scarcely two acres of pasture-land. One of these three patients, though thickly covered with pustules of small-pox, was not confined to her bed after the full development of the eruption, but frequently crossed the meadow to visit the other patients—a woman and a child—the former of whom was in great danger from the confluent malignant form of the disease, and died. According to custom, she was buried the same evening; but the intercourse between the cottages across the meadow was still continued. On the day following death, the wearing-apparel of the deceased, the bedclothes and bedding of both patients, were exposed for purification on the hedges bounding the meadow. The chaff of the child's bed was thrown into the ditch, and the flock of the deceased woman's bed was strewed about on the grass over the meadow, where it was exposed and turned every night, and for several hours during the day. This purification of the clothes continued for eleven days. At that time eight milch-cows and two young heifers were turned into the meadow to graze. They entered it every morning for this purpose, and were driven from it every afternoon. Whenever the cows quitted the meadow the infected articles were again exposed on the hedges, and the flock of the bed was spread out on the grass and repeatedly turned. These things remained until the morning, when the cows were readmitted, and the contaminated articles were supposed to be withdrawn. It appears, however, that the removal of the infected articles was not always accomplished so

punctually as had been enjoined, so that, on one occasion at least, the cows were seen in the midst of them, and licking up the flock of the bed which lay on the grass. These cows were in perfect health when first put out to grass in this meadow; but in twelve or fourteen days, five out of the eight milch-cows showed symptoms of sickness, and the whole of the cows were certainly affected within three days of each other," with the general symptoms of small-pox.

Immersion in water seems to have but little effect in destroying the germs of yellow fever and small-pox, for it has been noticed that an infected mattress thrown into the Mississippi River from a steamboat, and afterward recovered by persons living on the shore, communicated the contagion. The air is also infected by the presence of bodies dead of specific diseases. To such an extent is this the case that in many cities public funerals of persons who have died of certain specific diseases are forbidden. The so-called "sewer-gas" is simply air polluted by the various organic matters contained in the sewers; and, as the diseases have their specific seed or germ, it follows that they can not be spontaneously generated from a gaseous poison. Sewer-air, however, may be a carrier of infection when the seed is sown, and it is certain that sewage itself, and the cryptogamic growths on the sides of sewers and house-drains, afford a favorable field for the propagation and development of fever-germs, especially typhoid fever, scarlet fever, and diphtheria; and, when the excreted matters from a typhoid-fever patient are conveyed into the sewer, they may then affect the air passing through it, gain entrance into the house, and in this manner spread the infection. If it were possible to prevent the discharges from typhoid-fever patients, and expectorated matter from patients suffering with diphtheria, from gaining entrance to the sewers, it is doubtful, in view of existing theories, if sewer-air could ever be a means of propagating these infections.

**WATER AS A CARRIER OF INFECTION.**—The most frequent means of propagation of typhoid fever as well as cholera is by water-carriage of the germ. The several outbreaks of typhoid that have occurred in England and this country have been traced, without much possibility of error in the conclusion, to water used for drinking purposes having become infected with the excreta from typhoid-fever patients. In a recent epidemic in England it is believed that it was due to the washing of milk-pans with polluted water!

Dr. MacNamara states: "The eighth characteristic of cholera is that the more explicit the examination the clearer the fact appears that the disease in the majority of cases spreads from one human being to another by means of the cholera fomes finding its way into drinking-water, and thus into the intestines of other people." Of the truth of this proposition there is abundant evidence.

**FILTH AND SEWAGE.**—In consonance with the views expressed as to the specific origin of the infection named, it follows that no amount of filth, no amount of ordinary sewage, can produce epidemic disease of its own accord, unless the seed be previously sown. It is certain, however, that fever-germs are best propagated and attain their greatest malignity where filth is found in the greatest abundance. That it will not produce it is proved. An example illustrating this fact was recently given by Minister John M. Langston in regard to the sanitary condition of Port-au-Prince, Hayti ("Bulletins of Public Health," Marine Hospital Service, 1881, page 114): "The streets (of Port-au-Prince) are exceedingly foul, and police regulations of no sort are enforced. There is no regulation to oblige even the filthiest person to remove deposits from the streets, or from the gutters and sidewalks; and the harbor is also full of foul matter of every sort." Now, although this filthy condition had then existed for several years, in one of the hottest of climates, the filth itself saturated with moisture, and necessarily raised to the elevated temperature tending to develop the latent germs of yellow fever, if any were present, the city was free from it for a period of fifteen years up to 1879, although it raged in the adjacent islands. It is known that heat and moisture favor the development and propagation of specific fever-germs when once sown, with the exception of the small-pox virus, which attains its greatest malignity at a low temperature.

**SANITARY CONTROL.**—From what has been said as to the general nature of infection and the means for its propagation, the measures to be adopted for the sanitary control of epidemic diseases are almost self-apparent. They are such, in the first place, as will destroy the germs; and, in the second place, to enforce perfect cleanliness, so that the germs, although gaining entrance to the proper spot, shall not find a harboring-place for their propagation. One of the first things that should interest a municipal health officer is the sanitary history of his town or city. He should ascertain with especial care the periods at which epidemics of any kind have appeared in the city or village under his charge. Wherever possible he should ascertain by investigation the spot where the first case made its appearance, and, if possible, trace the source of infection. Then the directions in which it spread from the initial cases should be noted. Other things being equal, the average meteorological conditions of the locality being practically unchanged from year to year; the introduction of the infection in a particular manner will usually lead to the same result in any given year, as in the past, favored on the one hand by increased population and diminished on the other by its decrease. Having mastered the details as to the past history, he should next ascertain the present sanitary condition of the locality by the inspection of the place, and an examina-

tion of its vital statistics as reported to the proper officer, week after week; its cleanliness or uncleanness; bearing in mind its history and the sources from which infection is likely to be admitted. The natural influence of locality favoring the propagation and spread of certain diseases may be entirely changed by perfect cleanliness. The experience of the British in India, and the French in Africa, is on this point quite conclusive. Cholera is a disease believed to have originated in Asia (the banks of the Ganges being, perhaps, its native habitat, if, indeed, a place of nativity can be assigned to it). It is called Asiatic cholera, in recognition of the place of its nativity. Professor Blanc ("Cholera, how to Avoid and Treat it," London and Paris, 1873, p. 40) states: "While I was on special duty in Abyssinia, cholera gained the camp of the Emperor Theodore, where it was brought by recruits from Tigré, in May, 1866. This disease had been making havoc in Tigré. We were not surprised, therefore, to hear that it had spread over other provinces, and that several cases had already broken out in Kourota, a town situated on Lake Tana. The King's camp was pitched in a very unhealthy situation, on low, swampy ground. Fever, diarrhoea, and dysentery had prevailed to a great extent. The Emperor, in the hope of arresting the spread of the epidemic, moved his camp to the neighborhood of Kourota. A worse place he could not have selected. He first encamped on a low promontory south of Kourota, but the cholera had by this time broken out in the camp and hundreds were dying daily. He again moved his camp, this time to some high ground a mile or so north of the town. The church was so completely choked up with dead bodies that no more could be admitted, and the adjoining streets offered the sad sight of countless corpses, surrounded by the sorrowing relatives, awaiting for days and nights the hallowed grave in the now crowded cemetery. At last the Emperor asked for my advice. I told him to proceed at once by different routes and follow the many small streams that flow from the highland of Begende; to protect from pollution the water used for drinking; and, once on the plateau, to break up his army as far as possible, selecting a few healthy, isolated localities, where every fresh case that broke out should be sent. He acted upon this advice, and before long had the satisfaction of seeing the epidemic lose its virulence, and before many weeks disappear entirely." Dr. Blanc shows by the above case how much may be done by isolation and scattering into camps, and separation of the sick from the well, and, to indicate how much better the disease was managed in India, under sanitary control, cites the following instance:

"Cholera had been raging during May and June, 1872, in the Mahratta country, a well-populated district, stretching from the eastern slope of the Bombay Ghauts. The altitude of

this plateau averages 2,000 feet above the level of the sea. It is mostly composed of laterites, well cultivated, sparsely wooded, possessing a few running streams, more or less dried up in hot weather, and a moderate rain-fall for India. We had learned from the reports of the police and civil officers in charge of the districts that the epidemic was of a most virulent type. Some medical subordinates were sent to the localities most infected, and they confirmed the great extent and severe character of the outbreak. I was at the time civil surgeon of Sattara, a town of some 23,000 inhabitants. . . . Informed of the progress of the epidemic in the direction of Sattara, with the assistance of the civil authorities, the following sanitary measures were carried out: The whole town was thoroughly inspected, filth and rubbish were carted and burned to leeward of the town, drains were flushed, houses were whitewashed, gardens cleared out, and all excrementitious matters removed to trenches dug for that purpose near the city, and filled with earth. Policemen were stationed at the different roads leading to the city, provided with medicines to distribute to persons suffering from diarrhoea, and directed to accompany to a building set apart for the purpose any case of cholera that should be reported to them. The town fortunately receives an excellent supply of drinking-water from a small lake situated on a hill in the vicinity of Sattara. Policemen were posted at the reservoir which receives this water; the place around was kept clean and dry, and no one was allowed to bathe or wash clothes at it or in its vicinity. The inhabitants were warned not to use the water of their wells for drinking purposes, but to fetch it from the reservoir. They were also told to apply for medicine on the first appearance of diarrhoea, and that every case of cholera that declared itself in the town should be taken to the hospital, and that myself or my subordinates should be informed of the occurrence, when some one belonging to the hospital staff would visit the patients. In the beginning of July a few cases were admitted into the cholera hospital, one or two a day, during some eight or ten days. Every one of these cases had been contracted in the villages south of Sattara, the district where the cholera was at the time prevailing. All the discharges of cholera-patients were at once saturated with disinfectants, and buried in trenches dug for the purpose, and the clothes and bedding of all were destroyed. A good ventilation, fires, and disinfectants were used in and around the cholera-ward." Although Sattara was surrounded by villages, and in all of them the cholera raged for several weeks, not a case broke out in the city while under this management. About a mile from Sattara there was a military cantonment, composed of European civil and military troops. This cantonment had a strict quarantine enforced around it as long as a single case of cholera remained under treatment at the hospital, and for some

days afterward no communication was allowed between the town and the camp. It also escaped the general infection.

**CONTROL AFTER AN EPIDEMIC HAS BROKEN OUT.**—From the foregoing it will be seen that the most active measures should be taken to prevent the introduction of infectious or contagious diseases, preventive measures taking in all cases the highest rank, cleanliness and watchfulness being the most important. Dr. Blanc's plan at Sattara could not well be improved upon. Unfortunately, however, in the United States, a land of universal liberty, liberty is too often interpreted to mean license, and the people are impatient of sanitary regulations sufficiently rigid to prevent the introduction of specific diseases. It therefore follows that it is only in great public exigencies that the reasonable and necessary means for their prevention can be carried into effect. We must, then, make up our minds to combat disease after it has appeared and becomes epidemic, rather than expect to prevent it, in the present state of popular information upon this subject.

The common carriers of commerce are usually the vehicles by which diseases are transmitted from place to place. Ships and steam-boats afford more favorable conditions for the growth and propagation of germs than railway-cars, on account of the ever-present moisture in the vessels, and the greater humidity of the air immediately surrounding them. Maritime quarantines, therefore, are essentially necessary to guard against the natural tendency of water-craft to spread contagion, but it would be more in accordance with the nomenclature of the day if the term "quarantine" were abandoned and "inspection-station" substituted, for all vessels should be periodically inspected, whether infected or not. The sanitary inspector should be not only well informed in regard to fomites and the sanitary condition of the port or place from which the vessel has arrived, but he should be sufficiently versed in marine architecture to enable him to thoroughly examine every portion of the vessel. The crew and passengers should be mustered, and, if any are sick from contagious disease, they should be immediately removed from the vessel, and the state-room or berth, with the bedding therein contained, thoroughly fumigated and disinfected, or preferably burned, and the sick persons themselves removed to a hospital for contagious diseases, established for that purpose. If the vessel be otherwise thoroughly clean, she will be healthful, and may be allowed to pass without detention. On the other hand, should the vessel be found in an unclean state and the bilge-water foul, she should be pumped out as dry as possible, and thoroughly disinfected. It is always safe to pump out the bilge-water whenever opportunity offers. Various kinds of disinfectants have been recommended, but it has been found by experience that the one of most

easy application in such cases is sulphurous acid gas. This is applied by placing a brazier in which charcoal has been lighted in the place to be fumigated, and throwing on the red-hot coals, or in a basin placed thereon, a quantity of crude sulphur. As the sulphur burns, sulphurous acid gas is thrown off, and permeates every portion of the apartment in which it is placed. It is highly destructive to bacteroid growths. Before placing the brazier in the hold, the bilge-water may be replaced by new sea-water—itself a capital disinfectant—and again pumped out.

When a case of small-pox or yellow fever is found to exist in a house in town or city, practically the same measures should be taken—namely, removal of the sick to a special hospital, disinfection of the apartment, thorough fumigation of the entire house, and the prevention of well or unprotected persons gaining access to the apartment. If it be a house in a crowded portion of the city, it should be promptly quarantined, and the patient removed to a hospital for contagious diseases; or, if this be not practicable, the patient should be effectually isolated. All bedding and clothing exposed to infection, carpets, window-hangings, wall-paper—if the room be papered—picture-backs, when covered with paper, and everything capable of retaining the disease-germs, (fomites) should be burned or buried in a trench. When a case of cholera has appeared, the discharges from the bowels should be covered with chloride of lime, and, whenever practicable, thrown into a furnace. No such matters should be thrown upon the ground or allowed to gain access to the public sewer, and all persons should be warned to promptly check any attack of diarrhoea, however slight. By these means alone it is possible to prevent the spread of these epidemic diseases in town or city; provided, however, that the surroundings of the infected house be cleaned and properly disinfected. Out-door disinfectants for use in such cases consist of copperas, ordinary quicklime, or chloride of lime—the latter being the most powerful, but objectionable to many on account of its giving off chlorine, which has a very pungent, acrid odor.

Public funerals in all cases of death from small-pox, cholera, yellow fever, and diphtheria, should be prohibited and the coffins hermetically sealed; when this is impracticable on account of the expense, the same result may be attained by coating the body with tar. The practice of cremation instead of the ordinary inhumation is to be commended, on sanitary grounds, in all such cases.

**SANITARY CORDONS.**—Sometimes, however, cases of infectious disease have escaped control by the ordinary measures. In order to prevent the spread of the disease to contiguous villages, towns, and adjoining districts, it has been found expedient to establish a sanitary cordon about the town or city, while, at the same time, sanitary measures are being carried

on within it. A cordon consists of a body of police, militia, or military, patrolling a certain line, extending, according to the necessities of the case, a sufficient distance to completely invest the infected district. A better illustration can not be given of a sanitary cordon than the description of the manner in which it was managed in Russia, and more recently in the United States. The Oriental plague made its appearance in the district above Astrakhan, in Russia, about the middle of November, 1878. It prevailed along the river Volga, and upon its islands. The center of the malady was in the village of Wetjankaja, with a population of some seventeen hundred inhabitants. The Governor of Astrakhan telegraphed to the Minister of the Interior the report of the medical supervisor of the Cossack forces in the district of Astrakhan, Dr. Depner. A few cases had appeared in the previous year, but the disease had not become epidemic until, as before stated, November, 1878. From the 27th of November to the 9th of December, out of one hundred sick in Wetjankaja, forty-three died; and in less than a month two hundred and seventy-three persons died of the disease. It then spread from Wetjankaja to the surrounding villages, and was declared epidemic. "Dr. Koch and six army-surgeons became victims to the epidemic, the priest died, the Cossacks who attended the sick or removed the dead died; almost all died who in any way came in contact with the sick or dead." Dr. Depner then arrived at the conclusion that the only means for suppressing the disease was quarantining; and on the 11th of December Dr. Depner with Colonel Preibanow instituted measures. He could not prosecute further observations, however, for he himself fell sick with the plague. These facts being telegraphed to the Emperor of Russia, the imperial committee of ministers was convened, and the following rules were adopted, which received the imperial sanction:

"1. (a.) The inhabitants of the colony of Wetjankaja shall be transferred and distributed as shall seem best after a careful examination of the local requirements, the limit of the quarantine not to be overstepped.

"(b.) The appraisement of the movable and immovable property destroyed by fire, as likewise the fixing of the indemnities to be paid to

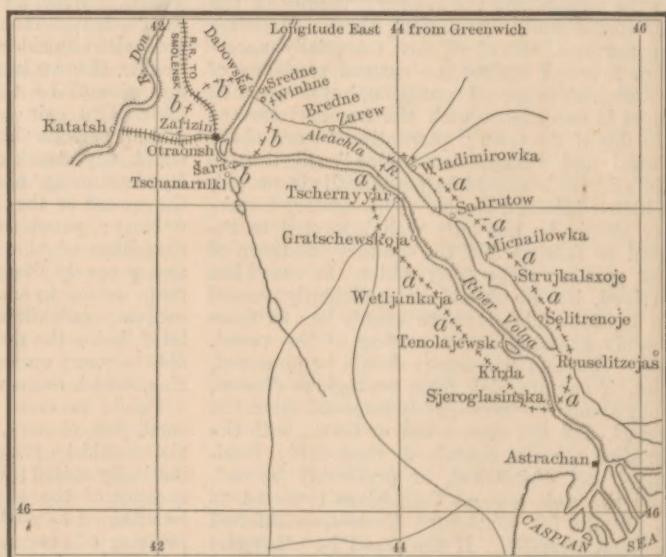
the owners, shall be reserved for a special commission, under the presidency of the Governor of Astrakhan, with the participation of members of the Cossack administration and of the Ministry of the Finances, the Ministry of the Domains, and the Ministry of the Interior, according to regulations which shall be prepared on the spot by the aforesaid commission.

"(c.) This commission shall be charged with the execution of all the measures that may be necessary for the destruction by fire of the colony of Wetjankaja, as likewise of all measures necessary to supply the population transferred from that colony with food, underclothing, and warm garments—to provide for the treatment of the sick, etc.

"2. That the acting Minister of the Interior may be authorized to extend the measures referred to concerning the colony of Wetjankaja, to other villages, as well as to isolated buildings everywhere, to such extent as shall be deemed indispensable.

"3. That three regiments of Cossacks may be immediately placed at the disposal of the civil administration for the quarantine service.

"4. That all outlays necessary for the execution of the measures above referred to, and to meet the expenses of all measures that may be required by the present epidemic, may be charged to the account of the imperial treasury."



[The lines *a a* represent the military cordon drawn around the infected villages; and *b b* the protective cordon maintained around Zarizin, an important commercial point and terminus of the Russian railway system. The village of Wetjankaja was the original and principal center of infection.—*Bulletin of Public Health.*]

It was the unanimous conclusion that "the plan of burning the colony of Wetjankaja (the center of the infection) is proposed after a thor-

ough examination of the question, and from a conviction of the indispensable necessity of so radical a measure for the extirpation of the disease in the locality where it first appeared—the committee having subsequently heard the opinion of the physicians present, both with regard to the measure in question, and in general in relation to the means which have been shown by science and experience to be best adapted to put a stop to an epidemic, and to prevent it from spreading."

In addition to the irregular troops mentioned above, bodies of infantry were placed at the disposal of the civil establishments, and unlimited credit was opened to meet all expenses from the Treasury. His Majesty the Emperor sent a special commissioner plenipotentiary. A commission was appointed to act in the matter, composed of medical specialists, whose duty it was to study the subject of the progress of the epidemic, and the proper means of stamping it out, and purifying the localities

measures adopted against it; and the instructions were carried out as above outlined, under the direction of Aide-de-Camp General Count Louis-Melikoff, who was sent to the infected locality with the rights and privileges of a temporary governor-general. On the arrival of Count Louis-Melikoff, in March, 1879, an international sanitary council was held, composed of the most distinguished sanitarians of Europe, Professors Hirsch, Besiadetsky, Cabiadis, Petrisco, and Eichwald. By the advice of this International Council, a general sanitary cordon was established all round the province of Astrakhan, with the object of protecting Russia and neighboring countries of the empire,\* and Professor Eichwald advised that the sanitary cordon should be maintained around the infected region until the 2d of May. These measures were entirely successful, and the plague did not spread to any other place outside of the originally infected district, nor has it reappeared.



then infected or those likely to become so; and in view of the impression produced in foreign countries by the reports of the plague, they should furnish to the government reliable information concerning the epidemic, and the

The efficacy of this plan, although on a much smaller scale, has been sufficiently shown in this country. Space is not sufficient to go into details regarding it, but an opportunity

\* See map on page 291.

occurred during the summer of 1882 to test it still further. A serious epidemic of yellow fever broke out in Bagdad, Tampico, and Matamoras, Mexico, and soon spread to Brownsville, in the State of Texas. There were in a short time, out of a city of some 5,000 inhabitants, between five and six hundred persons sick of yellow fever. A general panic prevailed throughout Southwestern Texas, and refugees were leaving that part of the State in great numbers, as it was believed the infection would rapidly and certainly extend to the surrounding country. In these circumstances, an appropriation of \$100,000 having been placed at the disposal of the Treasury Department by the President, to prevent the spread of epidemics, the Governor of the State of Texas applied to the Secretary of the Treasury for assistance from the General Government; and, as the exact area of the infected region was undetermined, at my suggestion a cordon was immediately established from Corpus Christi, on the Gulf, to Laredo, on the Rio Grande, along the line of the Texas and Mexican Railway. No person was allowed to pass this cordon until after ten days' detention at some one of the quarantine stations (represented by flags upon the accompanying map),<sup>\*</sup> that length of time being considered necessary to determine whether or not the particular person would be attacked with yellow fever. Baggage was not allowed to cross the line upon any pretext. A hospital was established in the city of Brownsville, a dispensary opened, and experienced physicians and nurses sent there, who were constantly employed in the treatment of the poor, and all persons unable to pay were treated and cared for at the public expense. These physicians also aided the health authorities of the city in carrying out sanitary measures, including the fumigation of houses.

As soon as practicable after opening the hospital, an inner protection cordon was established, thirty miles from Brownsville, the original cordon having been one hundred and eighty miles distant. Perfect liberty was allowed to the inhabitants of the infected city to leave at any time, and they were encouraged to scatter in camps; but they were not allowed to cross the cordon until after personal detention of ten days, and fumigation of their wearing-apparel; and, as in the case of the outer cordon, the crossing of baggage was positively interdicted. It was intended to remove the upper cordon between Laredo and Corpus Christi within ten days after the formation of the inner one, which extended from Santa Maria, on the Rio Grande, to the mouth of the Sol Colorado; but it was retained for several days longer, as certain of the refugees who had left Brownsville prior to the establishment of the Colorado cordon developed yellow fever. They were quarantined in the camps where they were, and their infected bedding and baggage burned. The fever continued its

spread and devastation on the Mexican side of the Rio Grande, and Reynosa, Camargo, Mier, and Guerrero successively became infected. It was then found necessary to protect the entire line of the Rio Grande, from Laredo to Santa Maria, a distance of nearly five hundred miles, by a cordon. The upper cordon, from Laredo to Corpus Christi, was then removed, and the line re-established along the Rio Grande, and the crossing-places carefully guarded; and, although the towns in Mexico were greatly devastated by the disease, there was no extension of it in Texas: on the contrary, it was confined to the limited district where it first appeared, bounded by the Colorado cordon on the one hand and the Gulf of Mexico upon the other. The Mexicans, seeing the good effects of the sanitary cordon in the United States, followed the example, and established quarantine stations in Mexico, guarding against the infected towns; and there, too, the quarantine proved successful, and arrested the spread of the disease. The Governor, the State Health Officer, and the State officers generally, assisted the work of the Government by all the means at their command. It was, however, opposed by the mayor of the city. In July, a few cases of yellow fever appeared in Pensacola, Fla., and later the disease became epidemic, and, as in Texas, a general panic prevailed. The villages and towns surrounding Pensacola established a rigid quarantine against it, no person from that city being allowed to enter except after proper detention and fumigation. In consequence of this, the towns that had thus protected themselves by the quarantine were not infected, and the disease did not spread, while the places adjoining, that did not quarantine against Pensacola, had the fever. The Government also protected its navy-yard, which joins the city of Pensacola, by means of a sanitary cordon and non-intercourse with the city during the prevalence of the epidemic, and it, too, escaped. With these facts and this experience to guide us, it may be safely asserted that with proper management it is possible to prevent the spread of epidemic diseases from one locality to another.

To prevent the recurrence of epidemics, it is necessary to adopt the same measures as those recommended in the beginning to prevent its original introduction. It is, that all fomites should be either carefully and well fumigated or destroyed, and the utmost cleanliness should be enjoined; and if it were possible to do so, as in the case of Russia, houses that are notoriously infected should be burned and their owners compensated from the public funds. It is greatly to be feared that the failure to burn infected bedding and clothing in Texas and Mexico may result in the reappearance of the yellow fever during the coming season. This disaster may be prevented if timely action be taken. It is, however, owing to the political constitution of the country, beyond the con-

\* See page 292.

trol or action of the officers of the United States.

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**EUROPE, AREA OF.** A very comprehensive work on the area of Europe has been published, during 1882, by General Strelitzky, of the Russian general staff, under the auspices of the Central Statistical Committee of Russia. It contains estimates not only of the land surface of the various countries, but also of the islands in the adjoining waters, the areas of the basins of the rivers, the areas covered by lakes both on the mainland and on the islands, also the areas of islands in the lakes, etc. In this work he estimates the total area of Europe at 10,410,486 square kilometres, or 3,865,210 English square miles, which are divided as follow among the twenty-three countries occupying Europe :

COUNTRIES.	Square miles.	Per cent of the total area of Europe.
Russia.....	2,129,289	54·9
Sweden and Norway.....	299,625	7·8
Austria-Hungary.....	241,563	6·3
Germany.....	208,502	5·4
France.....	205,985	5·3
Spain.....	198,294	5·
Turkey.....	190,140	3·4
Great Britain.....	121,466	3·2
Italy.....	111,410	2·9
Denmark.....	54,902	1·4
Roumania.....	50,736	1·3
Portugal.....	34,420	·9
Greece.....	19,815	·5
Servia.....	18,761	·5
Switzerland.....	15,978	·4
Netherlands.....	13,741	·3
Belgium.....	11,375	·3
Montenegro.....	3,630	·09
Andorra.....	175	·004
Lichtenstein.....	61	·002
San Marino.....	33	·0008
Monaco.....	9	·0002

Of the total area of Europe, the continent contains 3,608,750 square miles. The surface of the islands, which is about one fourteenth that of the continent, is 256,560 square miles, and is divided as follows among the different waters of Europe :

Islands in Sq. miles.	Islands in Sq. miles.
Atlantic Ocean..... 168,574	Adriatic Sea..... 1,296
Arctic Ocean..... 38,605	White Sea..... 191
Mediterranean Sea.... 32,522	Sea of Marmora..... 70
Baltic Sea..... 12,753	Sea of Azov..... 41
North Sea..... 2,487	Black Sea..... 21

Great Britain, which, with an insular territory of 121,464 square miles, possesses only two square miles of mainland, is followed by Denmark with 45,401 square miles of islands and 9,501 square miles of mainland. The insular territory of the other countries is as follows :

COUNTRIES.	Sq. miles.	COUNTRIES.	Sq. miles.
Russia.....	42,370	Spain.....	1,931
Italy.....	19,338	Austria.....	1,272
Norway.....	8,583	Germany.....	1,029
Greece.....	3,871	Netherlands.....	638
Turkey.....	3,920	Portugal.....	17
France.....	3,686	Romania.....	·4
Sweden.....	3,040		

The principal islands of Europe and their area are as follow :

ISLANDS.	In what waters.	Belonging to	Sq. miles.
Great Britain.....	Atlantic.....	Great Britain.....	84,088
Iceland.....	Atlantic.....	Denmark.....	39,545
Nova Zembla.....	Arctic.....	Russia.....	35,164
Ireland.....	Atlantic.....	Great Britain.....	32,388
Sicily.....	Mediterranean.....	Italy.....	9,860
Sardinia.....	Mediterranean.....	France.....	8,422
Corsica.....	Mediterranean.....	Turkey.....	8,317
Candia.....	Mediterranean.....	Denmark.....	2,686
Zealand.....	Baltic.....	Russia.....	1,429
Vaigats.....	Arctic.....	Greece.....	1,380
Eubea.....	Mediterranean.....	Spain.....	1,352
Majorca.....	Mediterranean.....	Russia.....	1,350
Kalquev.....	Arctic.....	Sweden.....	1,151
Gothland.....	Baltic.....	Denmark.....	1,136
Fünen.....	Baltic.....	Russia.....	1,010
Oesel.....	Atlantic.....	Norway.....	847
Hindöe.....	Atlantic.....	Great Britain.....	838
Senjen.....	Atlantic.....	Norway.....	612
Skye.....	Atlantic.....	Great Britain.....	592
Faröe.....	Atlantic.....	Denmark.....	514
Aland.....	Baltic.....	Sweden.....	510
Laaland.....	Baltic.....	Russia.....	444
Dagöe.....	Baltic.....	Norway.....	371
Soröe.....	Atlantic.....	Great Britain.....	362
Mainland.....	Atlantic.....	Rügen.....	343
Rügen.....	Baltic.....	Germany.....	342
Langöen.....	Atlantic.....	Norway.....	342
Mull.....	Atlantic.....	Great Britain.....	302
Minorca.....	Mediterranean.....	Spain.....	298
Vaagöe.....	Atlantic.....	Norway.....	280
Islay.....	Atlantic.....	Great Britain.....	278
Corfu.....	Mediterranean.....	Greece.....	278
Ringvadsee.....	Atlantic.....	Norway.....	273

The length of the principal rivers (in English miles), and the area of their basins (in square miles), are as follow :

RIVERS.	Length.	Area of basin.
Volga.....	1,973	563,302
Danube.....	1,528	815,486
Dnieper.....	1,061	208,462
Don.....	978	166,127
Dwina.....	357	141,077
Petchora.....	919	127,225
Neva.....	34	111,517
Rhine.....	708	75,796
Vistula.....	595	73,905
Elbe.....	611	55,341
Loire.....	543	46,755

The lakes of Europe cover an area of 84,829 square miles—that is, about 2 per cent of the total area of the continent. Of this number, 83,585 square miles are on the mainland and 1,244 square miles on the islands. The area covered by lakes in each country is as follows :

COUNTRIES.	On mainland.	On islands.	Total.
Russia.....	58,660	106	58,766
Sweden.....	14,276	18	14,294
Norway.....	3,951	...	3,951
Germany.....	2,198	...	2,198
Great Britain.....	...	1,011	1,011
Italy.....	775	89	814
Austria-Hungary.....	708	...	708
Turkey.....	696	...	696
Roumania.....	539	...	539
France.....	530	...	530
Switzerland.....	488	...	488
Portugal.....	201	...	201
Greece.....	176	3	179
Netherlands and Luxemburg.	166	...	166
Denmark.....	94	68	162
Montenegro.....	75	...	75
Belgium.....	2	...	2

These lakes contain 3,037 square miles of islands, of which 2,702 square miles are in Russia, 322 square miles in Sweden, 12 square miles in Portugal, and 1 square mile in Montenegro. The largest lakes in Europe are as follow :

